No longer true

Luca Barlassina, Fabio Del Prete

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Abstract There are sentences that express the same temporally fully specified proposition at all contexts—call them 'context-insensitive, temporally specific sentences.' Sentence (1) 'Obama was born in 1961' is a case in point: at all contexts, it expresses the proposition ascribing to the year 1961 the property of being a time in which Obama was born. Suppose that someone uttered (1) in a context located on Christmas 2000 in our world. In this context, (1) is a true sentence about the past. Moreover, it seems impossible that (1) will be false in a successive context (one located, say, on Christmas 2020 in our world). More generally, one might be tempted to endorse the following principle: if a context-insensitive, temporally specific sentence is uttered in a context in which it is about the past and takes a certain truth value in this context, it cannot be the case that it takes a different truth value in a successive context located in the same world. In this paper, we present linguistic evidence that shows that this principle fails. On this basis, we draw an apparently crazy conclusion: the past can change. We then explain why this conclusion is not that crazy, after all.

"He who controls the present controls the past"

George Orwell, *1984*

1. Introduction

Aristotle famously said that sentences about the past do not change their truth value as time goes by (*De Interpretatione*, Ch. 9). For example, if sentence (1) is true *now*, it will *always* be true.

(1) The trial of Socrates took place in 399 BC.

You might think it would be easy to show that Aristotle got this wrong. Consider, for instance, the following sentence about the past:

(2) President Obama gave his second inaugural address yesterday.

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Sentence (2) was true when uttered on January 22nd 2013. However, isn't it evident that it would no longer have been true if uttered again one day later?

If you were to reason along these lines, it'd be you to get it wrong: admittedly, (2) takes different truth values in those two contexts, but only because it says different things at those contexts—indeed, it says that Obama gave his second inaugural address *on Jan. 21st 2013* at the former, and that Obama gave his second inaugural address *on Jan. 22nd 2013* at the latter. If you wanted to show that Aristotle was wrong after all, you should thus find a sentence about the past saying the same thing at different contexts, and further show that it takes one truth value in a certain context and another value in a subsequent context. In this paper, we show that sentences which pattern in this way actually exist. On the basis of our finding, we shall draw two outrageous conclusions: first, even Aristotle can get things wrong; second, the past can change.

Too fast, you might say. Why should we believe it to be so difficult to find a sentence about the past saying the same thing at different contexts and taking different truth values at those contexts? Suppose that a journalist, Ms. Blue, was sent to report on the final match of the FIFA World Cup both in 1986 and 1990—as is well-known, the match was played between Argentina and West Germany on both occasions. Suppose further that Ms. Blue uttered sentence (3) at the end of the former match, and then again at the end of the latter:

(3) Argentina won the final against West Germany.

Since Argentina won the FIFA World Cup in 1986, but lost the final in 1990, (3) was true in the former context, but false in the latter. Moreover, you might say that (3) says the same thing at both contexts, namely, *that Argentina won the final against West Germany*. Thus, here it is what was being looked for. Apparently, it was a trivial task.

This point, however, rests on a misunderstanding. To clarify the issue, we shall now detail the main components of the framework we shall be working in. According to it:

A. People utter sentences in a context—*the context of utterance*.
B. A context (of utterance) c minimally has a world-coordinate c_w and a time-coordinate c_t and is represented as a n-tuple $<... \ c_w, \ c_t, \ ...>$—thus it specifies, among other information, in what world and at what time the sentence is uttered.
C. What is said by a sentence at a context is a *proposition*—something which determines a set of possible worlds.

D. A sentence is *context-insensitive* if it expresses the same proposition at all contexts. Otherwise, it is *context-sensitive*.

E. A proposition bears a truth value relative to a *circumstance of evaluation,* which is just a possible world *w*.

F. The circumstance (of evaluation) of *c* is the world of *c*.

G. A sentence *S* is *true in a context c* if and only if the proposition that *S* expresses at *c* is true relative to the circumstance of *c*.

We shall also make use of the following clauses for predicates:

C'. The content of an *n*-place predicate at a context is an *n*-place *property*—a function from worlds to sets of *n*-tuples of entities of the kind the property can be applied to.

D'. A predicate is *context-insensitive* if it expresses the same property at all contexts. Otherwise, it is *context-sensitive*.

E'. An *n*-place property applies to a *n*-tuple of entities relative to a possible world *w*.

By claiming in clause C that a proposition determines a set of possible worlds, we *ipso facto* claim that propositions are *temporally fully specified*—all the relevant time information is specified in the proposition (Stalnaker, 1984; Shaffer, 2012). The way in which we account for the fact that all sentences (in a context) express temporally fully specified propositions is by adopting a *referential theory of tense* (Partee, 1973; Abusch, 1988). According to this theory, the tense is a variable ranging over times, whose value is either determined by the context of utterance, as in (3) above, or bound by a temporal adverb, as in (4):

(4) Argentina won the final against West Germany in 1986.

It follows that (4) expresses the same proposition at all contexts, namely, *that Argentina won the final against West Germany in 1986*. On the other hand, (3) expresses this proposition when uttered by Ms. Blue at the end of the FIFA World Cup in 1986, while it expresses the different proposition *that Argentina won the final against West Germany in 1990* when uttered by her right after the FIFA World Cup in 1990. Thus, according to the view that we assume here, (3) patterns with overtly indexical sentences like (2) in being context-sensitive (cf. clause D above), and this is why the previous charge of triviality based on (3) was off-target.

You might still show some skepticism, despite our efforts to clarify. Suppose that John utters (4) in the actual world, while Twin-John utters it in another possible world. In the latter world, Argentina lost the FIFA World Cup final against West Germany in 1986, unlike what happened in the actual world. Thus, (4) is true in the context of John's utterance, but false in the context of Twin-John's utterance. Moreover, (4) is context-insensitive. Hence, it has been easily found what was being looked for. Again, the task has been shown to be trivial.

Once more, to dispel misunderstanding we need to be more precise about what we are interested in. Let's thus introduce the following terminology:

H. c' is a *same-world context* to c if and only if the world of c' is the same as the world of c.

I. c' is a *successive* (respectively, *preceding*) *same-world context* to c if and only if (i) the time of c' follows (respectively, precedes) the time of c and (ii) c' is a same-world context to c.

J. A sentence S is *truth-value-persistent* if, for any contexts c and c' such that c' is a successive same-world context to c, S takes the same truth value in c and c'. Otherwise S is *non-truth-value-persistent*.

K. Let S be a sentence whose tense, in a given context c, refers to a time t^*. Then, the proposition that S expresses at c *is about* t^* and ascribes a certain property to t^*.

L. A sentence S in a context c is *about the past* if and only if the proposition that S expresses at c is about a time that precedes c_t.[1]

M. A sentence S that is about the past in a context c is true in c if and only if the proposition expressed by S in c is true relative to the past history of c.

It might not be entirely clear how K and C, on the one hand, and M and G, on the other, hang together. Let us explain it. Clause C specifies what kind of information is contained in a proposition, regardless of whether propositions are structured or not; in particular, as we said

[1] The notion 'being about the past' should not be confused with the grammatical notion 'being past tensed.' While the latter pertains to syntax, or equivalently, to abstract sentence-types, the former belongs to pragmatics, which deals with sentences in a context. In fact, even a sentence grammatically marked as future can be about the past, in the sense which is defined in L in the main text. The 'will'-sentence in the historical narrative (i) should suffice to make the point clear:

(i) Napoleon is defeated by Wellington at Waterloo in 1815. He will die in exile on the island of Saint Helena in 1821.

above, C implies that propositions are temporally fully specified. Clause K says that propositions expressed by tensed sentences are in fact structured: they are such that a certain property is ascribed to a certain time. Turning now to M and G, the former can be seen as a way to apply the latter to the case of sentences about the past. Indeed, from the fact that a sentence *S* is about the past in a context *c*, it naturally follows that *S* is true in *c* if and only if *the past of the world of c* (in our terminology, 'the past history of *c*') is as the proposition expressed by *S* in *c* describes it as being. By putting all these things together, we get the following notion of *Truth about the Past*:

> *Truth about the Past*. Let *S* be a sentence that is about the past in a context *c* and let *p* be the proposition expressed by *S* at *c*. Then, *S* is true in *c* if and only if the time that *p* is about has, relative to the past history of *c*, the property that *p* ascribes to it.

We are now in a position to state the aim of our paper more precisely: finding a *context-insensitive, non-truth-value-persistent* (hereafter, *CINP*) *sentence about the past*, that is, a context-insensitive sentence that is about the past in a certain context and takes a certain truth value in it, while taking a different truth value in a successive same-world context. Notice that since John and Twin-John uttered (4) in two contexts that are not same-world contexts, their case does not present us with an instance of CINP sentence about the past. Again, the charge of triviality has been disposed of.[2]

At this point, you might raise a final worry. Granted, the task is not trivial. But why should it be of interest to us? The best answer to this question you will get by reading the rest

[2] One might argue that this task is not trivial only insofar as one adopts a theory according to which propositions are temporally fully specified. In fact, if one accepts that sentences can express temporally non-specified propositions, it seems extremely easy to find CINP sentences about the past. Sentence (3) ('Argentina won the final against West Germany') is a case in point: if one maintains that (3) expresses the temporally non-specified proposition *that Argentina won the final against West Germany* at all contexts, one can then argue that, relative to the two contexts considered in the main text, (3) is a context-insensitive sentence about the past which is furthermore non-truth-value-persistent—indeed, Argentina won in 1986 but did not win in 1990. In other words, assuming a theory of propositions different from ours but no less plausible than it, the task of finding a CINP sentence about the past would turn out to be trivial. This charge, however, is not legitimate. In fact, it is possible to formulate our problem as an interesting one independently of assuming any particular theory of propositions. In particular, one who adopts the view, endorsed by Kaplan (1989), Ludlow (2001), Recanati (2004), among others, according to which sentences like (3) express the same temporally non-specific propositions at all contexts, should just make the effort of restating the aim of our paper as follows: finding a context-insensitive sentence about the past *which expresses the same temporally fully specified proposition at all contexts* (for example, (4) 'Argentina won the final against West Germany in 1986'), but is nevertheless non-truth-value-persistent.

of this paper. This is what you are going to find next. In section 2, we introduce an argument—*the Argument for Truth Value Persistence*—which tries to give a principled reason of why there should not be CINP sentences about the past. In section 3, we present a *prima facie* CINP sentence about the past, and we argue in sections 4 and 5 that it is a *genuine* instance of this kind of sentences. If our case goes through, it follows that there must be something wrong in the Argument for Truth Value Persistence. In section 6, we present a model-theoretic analysis of CINP sentences about the past. On the basis of it, in section 7, we diagnose what is wrong in the Argument for Truth Value Persistence, namely, the assumption that the past cannot change.

2. The Argument for Truth Value Persistence

Suppose that in 1896, just before the Klondike Gold Rush started, there were more than two tons of gold in Klondike's mines. Suppose further that Ms. Green uttered (5) on November 20th 2010:

(5) There were more than two tons of gold in Klondike's mines in 1896.

Let C_0 be the context of Ms. Green's utterance, which we represent for simplicity as the pair $<w^*, 11/20/2010>$. Under the above suppositions, (5) is true in C_0. More interestingly, it seems that the truth value that (5) takes in this context will persist in the future: if someone uttered (5) in a context C_1 which is a successive same-world context to C_0—e.g., C_1 is the context $<w^*, 11/20/2012>$—(5) would be true in C_1 as well.

Why should (5) be truth-value-persistent in this way? Here is a plausible answer. Being (5) a sentence about the past, it follows from clause M in section 1 that its truth value in a context *c* only depends on two things:

(i) the proposition expressed by (5) in *c*,
(ii) the past history of *c*.

Hence, since (5) expresses the same proposition at all contexts (i.e., the proposition *that there were more than two tons of gold in Klondike's mines in 1896*), the only possibility for (5) to change its truth value in passing from C_0 to C_1 is that the past history of C_1 is different from the past history of C_0. In particular, given that the proposition expressed by (5) ascribes to the year 1896 the property of being a time in which there were more than two tons of gold in

Klondike's mines (see clause K in section 1), the only possibility for (5) to change its truth value in passing from C_0 to C_1 is that:

(a) *it is the case* at November 20th 2010 that, relative to the past history of C_0, the year 1896 has the property of being a time in which there were more than two tons of gold in Klondike's mines;

(b) *it is no longer the case* at November 20th 2012 that, relative to the past history of the successive same-world context C_1, the year 1896 has the property of being a time in which there were more than two tons of gold in Klondike's mines.

But how could this be? Apparently, the only possible difference between the past history of C_1 and the past history of C_0 is that the former incorporates the events that have come to happen in between C_0 and C_1, whereas the latter doesn't. On the other hand, it just doesn't seem possible that what is in the past history of the earlier context C_0 is no longer in the past history of the successive same-world context C_1. Therefore, one has good reasons to conclude that (5) cannot change its truth value from C_0 to C_1.

Generalizing from the previous considerations, one might propose the following argument against the existence of CINP sentences about the past:

The Argument for Truth Value Persistence

Let *S* and C_0 be such that C_0 is a context and *S* is a context-insensitive sentence about the past in C_0. Let *p*, *t*, and Q_p be such that *p* is the proposition expressed by *S* (at all contexts), *t* is the time in the past history of *c* that *p* is about, and Q_p is the property that *p* ascribes to *t*.

P1. For any context *c* in which *S* is about the past, *S* is true (false) in *c* iff Q_p does (not) apply to *t* relative to the past history of *c*.

P2. For any context *c* that is a successive same-world context to C_0 and for any property *P*, if *P* does (not) apply to *t* relative to the past history of C_0, then *P* does (not) apply to *t* relative to the past history of *c*.

P3. For any context *c* that is a successive same-world context to C_0, if Q_p does (not) apply to *t* relative to the past history of C_0, then Q_p *d*oes (not) apply to *t* relative to the past history of *c*.

[From P2 by elimination of the universal quantification over properties.]

C1. Therefore, for any context *c* that is a successive same-world context to C_0, if *S* is true (false) in C_0, *S* is true (false) in *c*.
[From P1 and P3.]

C2. Therefore, *S* is truth-value-persistent.
[From C1, by definition of *truth-value-persistent sentence*.]

The Argument for Truth Value Persistence says something simple and convincing. P1 is a semi-formal statement of the notion of *Truth about the Past* from section 1. P2 is a way to precisely state an intuitive idea on which there has been an almost universal consensus over centuries, namely, the metaphysical platitude that the past cannot change.[3] P3 is just a logical consequence of P2. Finally, C1 and C2 follow from the above premises by ordinary logic. However, there must be some error lying beneath this argument. Indeed, in the next three sections we'll show that CINP sentences about the past actually exist.

3. No longer the winner

It is July 23rd 2000. Being the rider with the lowest overall time at the end of the last stage, the Texan cyclist Lance Armstrong is declared the winner of the Tour de France by *Union du Cyclisme Internationale* (UCI). On Christmas 2002, when asked by his children who won the Tour de France in 2000, Frank utters (6):

(6) Lance Armstrong won the Tour de France in 2000.

Let's refer to the context of Frank's utterance as 'Context A.' Intuitively, (6) is *true* in Context A.

Time goes by. Having been suspicious for a while of Armstrong's striking performances, US Anti-Doping Agency starts investigating about the possibility that he may

[3] *Almost*, due to Ockham's (1321-24) criticism of the *Master Argument*. According to it, while there is a part of the past that is indeed necessary (or unmodifiable), there is also a part of the past that is contingent (or modifiable). The latter part consists of those facts (nowadays known as *soft facts*) which, in spite of being past, make reference to other facts that lie in the future and whose realization is still contingent on some agent's will. In Ockham's view, for example, while it is now necessary that Obama was elected President of the US in 2008, it is *not* now necessary that Obama was elected President of the US eight years before the Rio de Janeiro's Summer Olympics. Indeed, even if it has already been decided that the 2016 Summer Olympics will take place in Rio de Janeiro, it is still in our power to make it the case that the 2016 Summer Olympics will not take place in Rio de Janeiro. For this reason, the fact that Obama was elected President of the US eight years before the Rio de Janeiro's Summer Olympics counts as a soft fact about the past. Importantly, the case of CINP sentence about the past that we shall discuss in this paper does not involve soft facts about the past, and so cannot be regarded as pointing to exceptions to the necessity of the past of the kind considered by Ockham.

have been using banned substances. It turns out that this is actually the case. For this reason, on October 22nd 2012, UCI withdraws all of Armstrong's wins at Tour de France, including his win in 2000. Frank is not aware of the fact that Armstrong's titles have been erased. Thus, as he is talking with his nephews on Easter 2013, he utters (6) again. Let's refer to the context of Frank's second utterance of (6) as 'Context B.' This time, we have the intuition that (6) is *false* in Context B.

To sum up, we have a sentence here which seems to have the following characteristics all at once: it is context-insensitive, it is about the past in both Context A and Context B, and it takes one truth value in Context A and a different truth value in Context B, even though the latter is a successive same-world context to the former. In a nutshell, it seems that we have a CINP sentence about the past. Thus, we face a *prima facie* counterexample to the truth-value-persistence of context-insensitive sentences about the past.

But is (6) a *genuine* counterexample? There are two ways in which one can try to show that it is not. First, one can impugn the claim that (6) has changed truth value in passing from Context A to Context B. Second, one can accept this claim, while arguing that (6) takes one truth value in Context A and another one in Context B only because it expresses two different propositions at those contexts. We consider the former objection in section 4 and the latter in section 5.

4. No truth value change

For brevity, we shall refer to the two intuitions reported above concerning the truth value of (6) as follows:

(INT1) Sentence (6) is true in Context A.
(INT2) Sentence (6) is false in Context B.

The objection that (6) has not changed its truth value from Context A to Context B comes in two variants. We shall consider them in turn in section 4.1 and section 4.2.

4.1. Always false

The first variant of the objection consists in accepting (INT2) while rejecting (INT1). The line of reasoning underlying the objection can be sketched as follows: since Armstrong managed to have the lowest overall time at Tour de France in 2000 only by making use of banned performance-enhancing substances, (6) was *already false* in Context A. According to

this objection, we should thus abandon (INT1) and eventually recognize (INT3) as the correct intuition:

(INT3) Sentence (6) is false in Context A.

However, (INT3) rests on a confusion, by which the property *being the winner* is conflated with the property *being the moral winner*, or *being the person who deserves to win*. Once these two properties are conveniently distinguished, the intuition that (6) was already false in Context A disappears. Bear with us and you'll see that it is so.

The possession of the property *being the winner* is determined by a declaration by a competent authority. To wit, if a competent authority decrees *x* to be the winner, *x* is *ipso facto* the winner.[4] However, a competent authority can of course decree that *x* is the winner even though *x* does not deserve to be so proclaimed. Therefore, *x* can enjoy the property of being the winner without enjoying the property of being the moral winner (or being the person who deserves to win), and *vice versa*. Consider, for instance, the famous match between Argentina and England at the FIFA World Cup quarter-finals in 1986. As is well-known, Argentina won the match 2-1. However, the crucial score was achieved through a blatant violation of a rule, as player Diego Armando Maradona pushed the ball into the net with his hand. The referee did not see the infraction and allowed the score. Most importantly, in spite of TV evidence of Maradona's misdeed, FIFA officials declared that Argentina won the match. Thus, even though Argentina was not the *moral winner* of the match, it was nonetheless the *winner*, since the competent authority so decreed.

With this in mind, ask yourself again: was (6) true when uttered in Context A? Needless to say, Armstrong was not the moral winner of the Tour de France in 2000. Therefore, (6) would be false in Context A if it ascribed the property of being the moral winner to Armstrong. However, (6) does not ascribe such a property to him. It rather ascribes to Armstrong the property of *being the winner*. Hence, since on July 23rd 2000 a competent authority had declared Armstrong the winner, and this declaration was still valid on Christmas 2002, it follows that (6) was true when uttered in Context A. Our conclusion is that the first variety of the objection does not work: (INT1) is indeed a correct intuition, while (INT3) is not. Let's now assess whether the second variety fares any better.

[4] In section 7, we will discuss the metaphysical status of a property like *being the winner* at a greater length.

4.2. Always true

The second variety of the objection consists in accepting (INT1), while rejecting the intuition that (6) is no longer true after the revocation of Armstrong's titles—hence, this variety rejects (INT2). The correct intuition concerning the truth value of (6) in Context B would rather be the following:

(INT4) Sentence (6) is true in Context B.

This time, the objection has some bite. Indeed, one can try to support (INT4) by exploiting the platitude that sincere speakers only assert what they take to be *true* sentences and then pointing to cases in which sincere and informed speakers seem to assert (6), or sentences implying (6), after the revocation of Armstrong's titles on October 22nd 2012. Our opponent will point to discourses like the following ones:

(7) Armstrong won the Tour de France seven times from 1999 to 2005. He was later stripped of those titles by the USADA for doping.
(*USA Today*, June 28th 2013).[5]

(8) The American won seven times straight, before being disqualified for systematic doping.
(*The Australian*, July 13th 2013).[6]

(9) Cycling is fighting drug use as it struggles to get past a legacy of widespread doping—especially during the mid-90s and 2000s, the era when Lance Armstrong won seven Tour titles before being stripped of them last year for serial doping.
(*The Big Story*, 5 Things to Know about Tour de France, July 4th 2013).[7]

On the basis of (7)-(9), our opponent will conclude that sincere and informed speakers have the intuition that (6) is still true after the revocation of the titles, and hence it is still true in Context B.

[5] http://www.usatoday.com/story/sports/cycling/2013/06/28/lance-armstrong-impossible-win-tour-de-france-doping/2471413/

[6] http://www.theaustralian.com.au/sport/opinion/chris-froome-looking-just-too-good-in-yellow-jersey-at-tour-de-france/story-e6frg7t6-1226678708461#mm-premium

[7] http://bigstory.ap.org/article/5-things-know-about-tour-de-france-5

Faced with this objection, we propose a two-step reply. First, the existence of (INT4) would not *per se* undermine our claim that there are CINP sentences about the past. In fact, it is sufficient for our case to go through that competent and informed speakers also have (INT2). Interestingly, the existence of the latter intuition can be established by adopting the same strategy that our opponent has just put in place against us, namely, looking for assertions by sincere and informed speakers that imply that (6) would be false if uttered after October 22nd 2012. As a matter of fact, there are plenty of such assertions, some of which are the following:

(10) UCI president Pat McQuaid maintains that 'Armstrong has no place in cycling.' So, who won the Tour de France 1999-2005? No one.[8]
(*Law, Economics & Cycling*, October 22nd 2012).[9]

(11) Lance Armstrong has no longer won any Tour de France titles.[10]

(12) Lance Armstrong is no longer the winner of the Tour de France from 1999-2005.
(Christian Prudhomme, Director of the Tour de France, from *CBSNews*, October 22nd 2012).[11]

These discourses support (INT2) for the following reasons. First, from the claim that no one won the Tour de France from 1999 to 2005, embedded in (10), it follows that Armstrong did not win the Tour de France in 2000. Analogously, from the claim that Armstrong has no longer won any Tour de France titles, it follows that Armstrong did not win the Tour de France in 2000. Finally, since from the fact that *x* won the Tour de France in the year *y* follows that *x* is the winner of the Tour de France in *y*, asserting that Armstrong is no longer the winner of the Tour de France from 1999 to 2005 also implies that Armstrong did not win any Tour de France titles from 1999 to 2005, which in turn implies that he did not win the Tour de France in 2000.

The second step in our reply is to show that (7)-(9), rather than constituting evidence in support of (INT4), actually constitute evidence against it. Let us explain this point. (7)-(9)

[8] A historical note: the Tour de France titles for the period 1999-2005 have not been reallocated.

[9] http://cyclingprof.blogspot.fr/2012/10/congratulations-to-no-one.html

[10] https://twitter.com/TheCodyG/statuses/238835618472423424

[11] http://www.cbsnews.com/ 8301-400_162-57537025/ lance-armstrong-stripped-of-tour-de-france-medals/

seem to support (INT4) for two reasons. First, discourses like (7), in which two sentences S_1-S_2 are concatenated, are *usually* interpreted as logical conjunctions [S_1 & S_2], hence as entailing each one of S_1-S_2. Therefore, given that the conjunct S_1 in (7) ('Armstrong won the Tour de France seven times from 1999 to 2005') entails (6), one might conclude that (7) as a whole entails (6). Second, complex sentences of the form [S_1 before S_2] are *usually* understood as entailing their component sentence S_1 (Beaver and Condoravdi, 2003; Heinämäki, 1974).[12] Hence, given that both S_1 in (8) ('The American won seven times straight') and S_1 in (9) ('Lance Armstrong won seven Tour titles') contextually entail (6), it might appear safe to conclude that both (8) and (9) contextually entail (6).

This line of reasoning, however, is flawed. If (7) really entailed its S_1-component, i.e., 'Armstrong won the Tour de France seven times from 1999 to 2005,' the addition of sentence (13) to (7) should result in a contradiction, given that (13) and the S_1-component of (7) are logically incompatible:

(13) Armstrong never won any Tour de France in the end.

However, the following discourse is perfectly consistent:

(14) Armstrong won the Tour de France seven times from 1999 to 2005. He was later stripped of those titles by the USADA for doping. *So, Armstrong never won any Tour de France in the end*.

Therefore, (7) does not entail its S_1-component. Hence, given that (7) could entail (6) only in virtue of entailing its S_1-component, it follows that (7) does not entail (6) either. The same applies, *mutatis mutandis*, to (8) and (9). If (8) entailed 'The American won seven times straight' and (9) entailed 'Lance Armstrong won seven Tour titles,' the following discourses should be contradictory:

(15) The American won seven times straight, before being disqualified for systematic doping. *So, he never won in the end.*

[12] As remarked by these authors, who follow Anscombe (1964) on this point, sentences of the form [S_1 before S_2] behave asymmetrically with respect to the entailment of their component clauses: although they normally entail their main clause S_1, they sometimes fail to entail their subordinate clause S_2 in so-called cases of counterfactual 'before', e.g. 'Mozart died before he finished the Requiem.'

(16) Lance Armstrong won seven Tour titles before being stripped of them last year for serial doping. *So, he did not win any Tour titles in the end.*

However, (15) and (16) are not contradictory at all!

But how is it possible that (7)-(9) do not entail (6)? Didn't we say that sentences of the form [S_1 before S_2] are usually interpreted as entailing S_1, while discourses of the form [S_1 + S_2] as being logical conjunctions [S_1 & S_2], which, in their turn, entail S_1? *Usually*, indeed. What is peculiar about (7)-(9) is that they involve *non-monotonic* reasoning: (6) does follow from S_1 alone; however, from S_1 *taken together with* the further piece of information that Armstrong's titles have been withdrawn, (6) does no longer follow. What's more, once the information of the titles' withdrawal has been added to S_1, it follows that (6) is no longer true. Hence, discourses like (7)-(9), rather than providing linguistic support for (INT4), constitute evidence against it. The reason is that, after the title's withdrawal, (6)—and sentences implying (6) alike—is uttered by sincere and informed speakers *only along with* sentences that defeat the inference to Armstrong's win and license the conclusion that he didn't win.

4.3. Taking stock

What's the upshot of all this? In section 4.1, we established that (INT1) is correct, while (INT3) can be easily explained away as due to a conflation between the property of being the winner with the property of being the moral winner. In section 4.2, we showed that discourses like (10)-(12) provide significant linguistic evidence for the correctness of (INT2), while (INT4) does not stand up to scrutiny. In view of all this, we can safely conclude that sentence (6) *did* change its truth value from Context A to Context B. Still, we acknowledge that (INT4) can exert a certain appeal. For this reason, in section 6 we shall provide a semantic analysis that not only accounts for (INT1) and (INT2), but makes it also possible to explain (INT4) away. Before doing that, however, we have to meet the second objection that we have briefly mentioned at the end of section 3.

5. Against context-insensitivity

Another way in which one might try to block our case for the existence of CINP sentences about the past is as follows: accepting that (6) undergoes a change in truth value from Context A to Context B, but arguing that the proposition that is false in Context B is not the same proposition that is true in Context A. In particular, one might try to analyze (6) along

the same lines as epistemic contextualists have analyzed knowledge ascriptions (Cohen, 1988, 1999; DeRose, 1992; Lewis, 1996).

If uttered during an ordinary conversation, a sentence like 'Angela Merkel knows that she has hands' seems to be clearly true. On the other hand, it seems false if uttered during a discussion on skepticism. The contextualist about knowledge ascriptions explains these contrasting intuitions by maintaining that this sentence expresses two different propositions at those contexts. This comes about because predicates of the form 'knows that *p*' are context-sensitive, thus they may express different properties at different contexts.

There are two ways in which this proposal can be implemented. According to *indexical contextualism*, the verb 'know' is an indexical expression in Kaplan's (1989) sense—i.e., it displays the same kind of context-dependence as 'I,' 'here' and 'now,' and its content at a context *c* depends on what epistemic standards are in play at *c* (Cohen, 1988; DeRose, 1992) or, equivalently, on what alternatives are relevant in *c* (Lewis, 1996). According to *non-indexical contextualism*, on the other hand, the predicate 'knows that *p*' is context-sensitive by way of containing an implicit variable ranging over epistemic standards. This variable either gets a certain epistemic standard as its semantic value from the context of utterance, or is bound by an operator occurring in the sentence (see Stanley 2005 for discussion).

The contextualist might maintain that the predicate 'won the Tour de France in 2000' is context-sensitive in one of the two aforementioned ways. The indexical contextualist will propose that the verb 'win' is an indexical, with the content of 'win the Tour de France in 2000' at a context *c* being a function from worlds *w* to sets of individuals *i* such that *i* wins the Tour de France in 2000 in *w* according to the declaration that is relevant in context *c*. On the other hand, the non-indexical contextualist will propose that the predicate 'win the Tour de France in 2000' contains an implicit variable ranging over declarations. On both accounts, given that (6) does not contain an operator that may bind a variable of this kind (if there is any such variable), and given that two different declarations are relevant in Context A and Context B, (6) is predicted to express proposition (17) at Context A and proposition (18) at Context B:

(17) *that Lance Armstrong won the Tour de France in 2000 according to UCI declaration of July 23rd 2000* (hereafter 'declaration α');

(18) *that Lance Armstrong won the Tour de France in 2000 according to UCI declaration of October 22nd 2012* (hereafter 'declaration β').

The only difference between the indexical and the non-indexical contextualist is that while the former will maintain that (6) has a simple Logical Form as in Fig. 1a below, the latter will claim that the Logical Form of (6) is the more complex structure given in Fig. 1b below, where the 'according to'-phrase fills in an argument inside the VP 'win the Tour de France in 2000.'

If the contextualist (indexical or non-indexical alike) is right, our case does not constitute a counterexample to the truth persistence of context-insensitive sentences about the past, given that (6) takes one truth value in Context A and another truth value in Context B only because it expresses one proposition at the former context and a different proposition at the latter. But is the contextualist right? We now show that she is not.

Fig. 1a. Logical Form of (6) according to indexical contextualism.

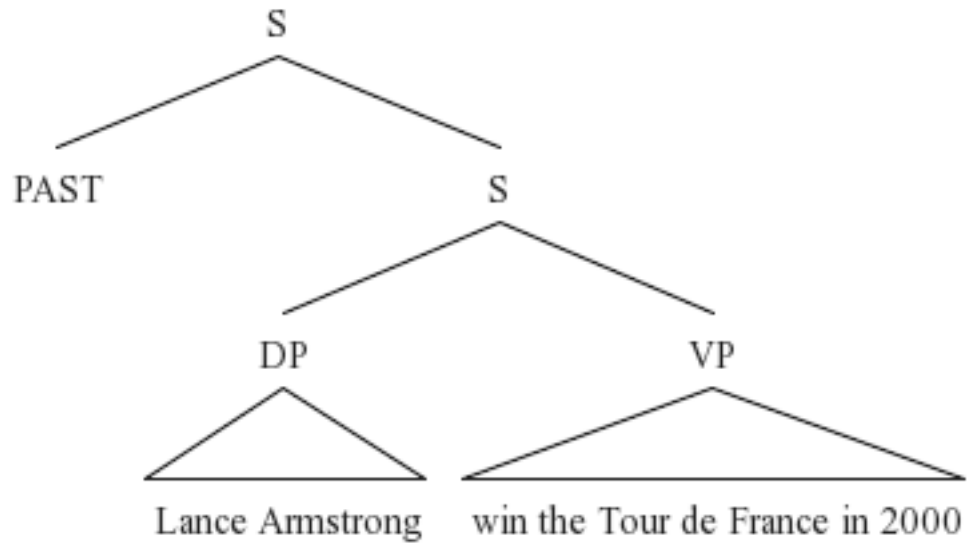
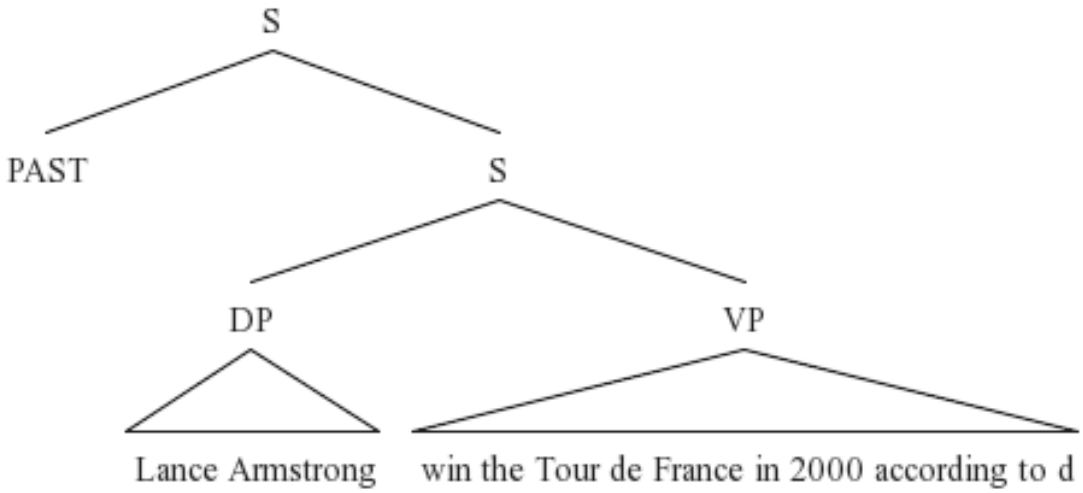


Fig. 1b. Logical Form of (6) according to non-indexical contextualism.



Suppose that, having come to know that Armstrong's titles have been revoked by declaration β, Ms. Blue asserts sentence (19) on Easter 2013:

(19) It is no longer the case that Lance Armstrong won the Tour de France in 2000.

Since the context of Ms. Blue's utterance shares the world and the time with Context B, while differing from Context B only in irrelevant respects, we refer to it as 'Context B*.' There is a clear intuition that (19) is true in Context B*—let's call this intuition '(INT5).' The contextualist, however, runs into deep trouble when trying to account for it, no matter which variant of the theory she adopts.

According to both indexical and non-indexical contextualism, sentence (19) expresses the following proposition in Context B*:

(20) *that it is no longer the case that Lance Armstrong won the Tour de France in 2000 according to declaration β.*

This is so because there is no operator binding the implicit variable (if there is any) and the declaration that is relevant in the context is declaration β. Again, the two varieties of contextualism assign two different Logical Forms to (19), namely those in Fig. 2a and Fig. 2b:

Fig. 2a. Logical Form of (19) according to indexical contextualism.

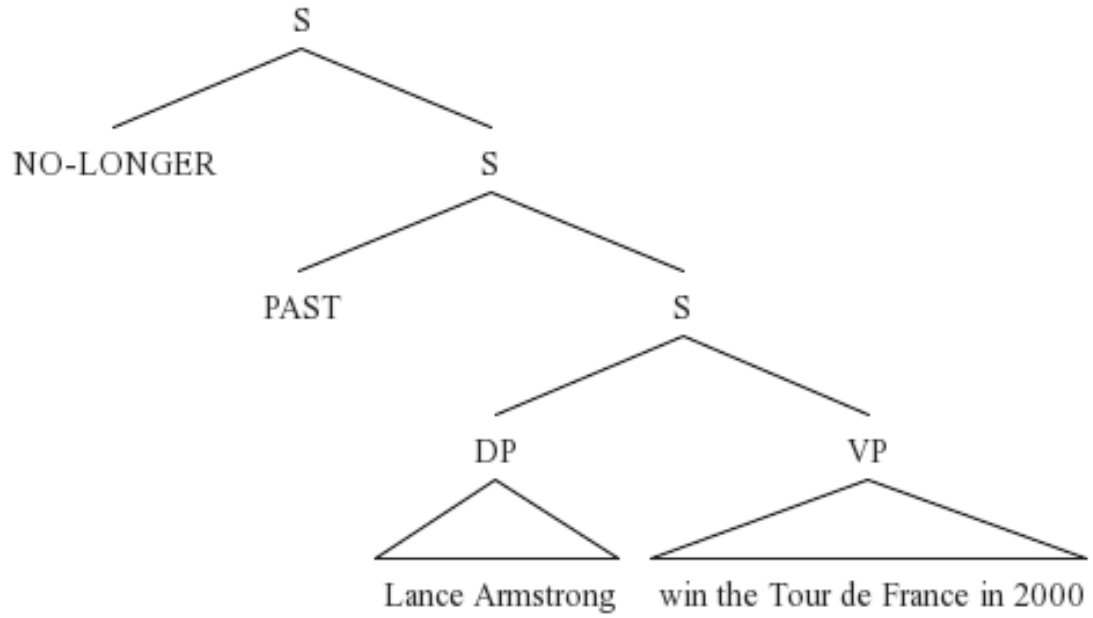
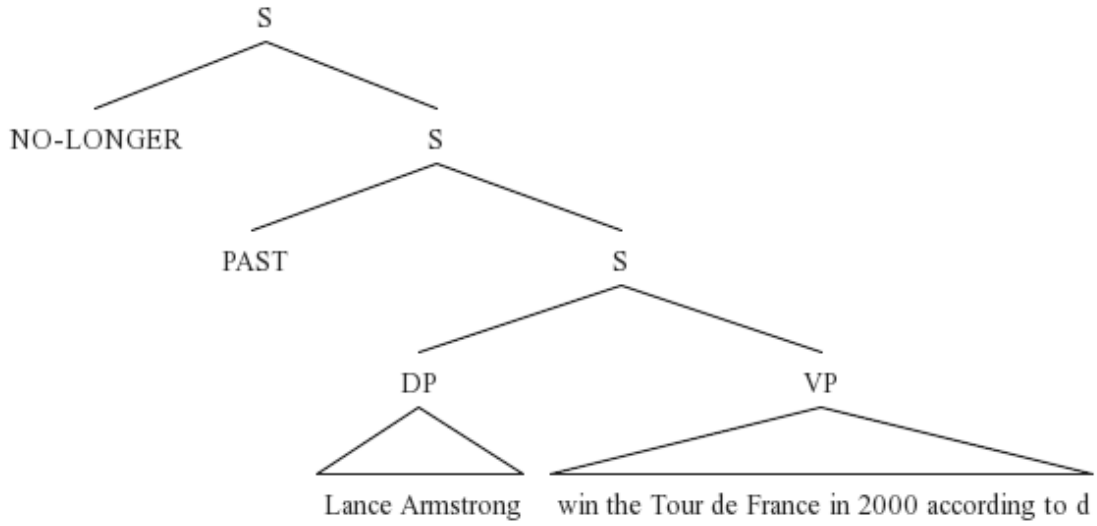


Fig. 2b. Logical Form of (19) according to non-indexical contextualism.



Importantly, given the Logical Forms in Fig. 2a and Fig. 2b, the *according to* constituent of proposition (20) cannot be read as out-scoping the *no longer* constituent.[13] In other words, proposition (20) should not be read in the following way:

[13] A more precise way to make this point is as follows. For the indexical contextualist, reference to the contextually relevant declaration is local to the lexical verb 'win', hence, there is no 'according to' constituent that can take *that it is no longer the case that Lance Armstrong won the Tour de France in 2000* in its scope. On the other hand, the non-indexical contextualist assumes that there is an 'according to' syntactic constituent at the level of the Logical Form. Still, this constituent comes into the proposition to saturate a hidden internal

(20') *that according to declaration β, it is no longer the case that Lance Armstrong won the Tour de France in 2000.*

Rather, (20) should be read as presupposing that it was true in the past that Armstrong won the Tour de France in 2000 according to declaration β. But this presupposition is false in Context B*. Indeed, since declaration β established the revocation of Armstrong's titles, it has never been the case that, relative to the past history of Context B*, Armstrong won the Tour de France in 2000 *according to β*. Therefore, sentence (19) cannot be true in Context B* in virtue of expressing proposition (20) at that context. Hence, both indexical and non-indexical contextualism fail in their attempt to account for (INT5).

It follows from this that the contextualist attempt to block our case for the existence of CINP sentences about the past doesn't succeed. Contextualism, however, was the last obstacle in the way of establishing the existence of CINP sentences about the past. Having overcome it, we can eventually assert with confidence that there are context-insensitive, non-truth-value persistent sentences about the past. After all, Aristotle was wrong.

The aim of the next section is to show that by assuming that the predicate 'to win the Tour de France in 2000' is context-insensitive, it is possible to provide a semantic analysis that accounts for (INT1), (INT2), (INT5) and explains away (INT4). Given that the context-insensitivity of the predicate 'to win the Tour de France in 2000' entails the context-insensitivity of (6),[14] and (INT1)-(INT2) entail that (6) changed its truth value from one context to a successive same-world context, our semantic analysis will constitute a theoretical vindication of CINP sentences about the past. This will also pave the way to the conclusion that the past can change.

6. The analysis

We shall present our analysis in an informal way first—section 6.1—making explicit the main insights underlying it. We shall then proceed to formulate the analysis in a full-blown compositional semantic framework—section 6.2.

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argument in the Verb Phrase 'win the Tour de France in 2000', thus its scope must be bounded to the VP and consequently cannot out-scope 'no longer.'

[14] This is the case because (6) does not contain other constituents, besides the verb predicate, that may make it context-sensitive. One might oppose that there actually is an ingredient of (6), other than the verb predicate, that may make this sentence context-sensitive, namely the tense. However, even if tense introduces an element of context-sensitivity in the sentence meaning (as it does in the formal analysis proposed in section 6.2, in which it introduces a definedness condition for the meaning of a past tensed sentence in a context *c* which makes reference to *the time of c*), this element is easily shown to be totally irrelevant to the issue that is of interest to us in this paper.

6.1. Informal analysis

As was said earlier on, the distinctive feature of our analysis, which tells it apart from the contextualist analysis, is the assumption that the predicate 'to win the Tour de France in 2000' expresses the same property at all contexts. Hence, sentence (6) expresses the same proposition at all contexts, namely (22):

(6) Lance Armstrong won the Tour de France in 2000.

(22) *that Lance Armstrong won the Tour de France in 2000.*

Having said this, let's begin with accounting for (INT1)—the intuition that (6) is true in Context A.

Being sentence (6) about the past in Context A, in order for it to be true in that context, proposition (22) has to be true relative to the past history of Context A (see clause M from section 1). Hence, given that proposition (22) ascribes to the year 2000 the property of being a time in which Lance Armstrong won the Tour de France (see clause K from section 1), for (6) to be true in Context A the past history of Context A must be such that the year 2000 has the property of being a time in which Lance Armstrong won the Tour de France. Therefore, to account for (INT1), we only have to posit that the past history of Context A is such that the year 2000 has such a property. And we shall indeed posit it. Thus, assuming that time can be graphically represented as a left-to-right oriented line, and a world-history as one such line furthermore decorated with events and contexts, the past history of Context A—call it 'h_0'—can be depicted as in Fig. 3.

Fig. 3. The past history of Context A.

Let's turn now to accounting for (INT2)—the intuition that (6) is false in Context B. A natural assumption is that, as time flows from a point t_0 to a subsequent point t_1, the only thing that happens is that new events come in place after time t_0, with no modification of the events that had already come in place before t_0. On the basis of this assumption and the representation in Fig. 3 above, one might be tempted to represent the past history of Context

B—call it 'h_0^+'—as a history in which (a) the year 2000 has the property of being a time in which Lance Armstrong won the Tour de France and (b) the year 2012 has the property of being a time in which Lance Armstrong's titles were revoked (Fig. 4).

Fig. 4. A "natural" hypothesis concerning the past history of Context B.

It is immediate to see, however, that this representation of the past history of Context B won't do. In fact, being (6) about the past in Context B, in order for it to be false in that context, proposition (22) has to be false relative to the past history of Context B. Hence, for (6) to be false in Context B, the past history of Context B must be such that the year 2000 does *not* have the property of being a time in which Lance Armstrong won the Tour de France. However, the representation of the past history of Context B given in Fig. 4 is such that the year 2000 *does* have that property. Thus, this representation wrongly predicts that (6) is still true in Context B.

In order to account for (INT2), it must be posited instead that the past history of Context B is such that the year 2000 does *not* have the property of being a time in which Lance Armstrong won the Tour de France. This forces upon us a representation of the past history of Context B as in Fig. 5, which is the representation that we assume to be correct.

Fig. 5. The past history of Context B.

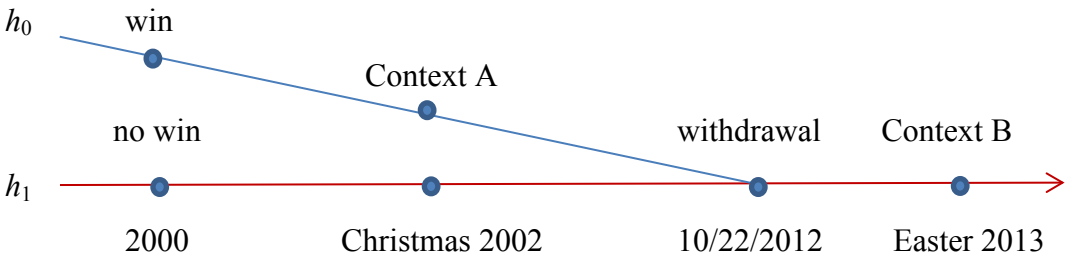
At this point, one might give an argument to the effect that the representation of the past history of Context A in Fig. 3 and the representation of the past history of Context B in Fig. 5 cannot stay together. Here is the argument:

The To Have and Have Not Argument

Context B is a successive same-world context to Context A, hence Context B is located in the same world as, and at a later time than, Context A. Accordingly, it is natural to maintain that h_0 (the past history of Context A) is a proper part of h_1 (the past history of Context B). However, the representation of h_0 in Fig. 3 is such that h_0 has the property of being a history in which the year 2000 has the property of being a time in which Lance Armstrong won the Tour de France. On the other hand, the representation of h_1 in Fig. 5 is such that h_1 is a history *not* having the property of being a history in which the year 2000 has the property of being a time in which Lance Armstrong won the Tour de France. Therefore, on the assumption that h_0 is a proper part of h_1, it follows that h_1 both *has and doesn't hav*e the property of being a history in which the year 2000 has the property of being a time in which Lance Armstrong won the Tour de France. Of course, this is absurd.

We agree: it would be entirely absurd to maintain that a history has and doesn't have a certain property. This is exactly why we maintain that the representation in Fig. 3 and that in Fig. 5 picture *different* past histories: relative to one of these, namely h_0, the time 2000 has the property of being a time in which Lance Armstrong won the Tour de France; relative to the other, namely h_1, the same time does not have that property. Crucially, however, since Context A and Context B are same-world contexts, h_0 and h_1 are different past histories *of the same world*. Therefore, the proper representation of the world that these two contexts share cannot be "mono-historical," but must be "bi-historical"—as shown by the representation in Fig. 6, which we obtain by merging the representations in Fig. 3 and Fig. 5 above.

Fig. 6. The past history of Context B (red line) and the past history of Context A (blue line).



You might wonder what this exactly means. Here is our answer, which is very simple and utterly unbelievable at the same time. The hypothesis concerning the past history of

Context B represented in Fig. 4 and the *To Have and Have Not Argument* given above suffer from the same problem: both of them take the intuitive idea seriously that when time flows from a time t_0 to a subsequent time t_1, new events come in place after t_0, while everything that happened before t_0 is left unchanged. As we have seen, however, to account for both (INT1) and (INT2), one has to give up such an intuitive conception of the flow of time and endorse the bi-historical representation we have proposed in Fig. 6 above. According to the latter, we had lived for some time on a world-history in which Armstrong won the Tour de France in 2000*,* namely h_0. We don't know when this world-history started, but we know when it ended: on October 22nd 2012, the day on which UCI erased all of Armstrong's wins at the Tour de France. Importantly, just as the declaration by UCI of July 23rd 2000 had been sufficient to make it the case that Armstrong had the property of having won (hence, being the winner of) the Tour de France in 2000, the declaration by UCI of October 22nd 2012 was sufficient to determine that Armstrong did not have that property any longer. To put it more bluntly, the UCI declaration of October 22nd 2012 had *retroactive effect*, and thus *changed the past*: from immediately after the declaration of July 23rd 2000 to an instant before the UCI declaration of October 22nd 2012, the past of our world was such that Armstrong did win the Tour de France in 2000; right after the titles' withdrawal, however, the past of our world did not contain that event anymore. Therefore, the flow of time from Christmas 2002 (the time of Context A) to Easter 2013 (the time of Context B) was such that, not only did new events come in place after Christmas 2002, but also what preceded Christmas 2002 changed. This is how we modeled this change: the declaration by UCI of October 22nd 2012 made world-history h_0 become a dead history and put world-history h_1 into being.

Some further clarifications are in order. First, the switch from h_0 to h_1 is not to be thought of as the switch from one possible world to a different possible world. Crucially, in passing from Context A to Context B (and Context B* alike), we stay in the *same world*. To put it differently, Context B is a successive same-world context to Context A, and the two only differ from one another with respect to how the past of the world they share was like. Second, one should not read the bi-historical representation in Fig. 6 as describing two co-occurring actual past histories. In fact, h_0 was actual until October 22nd 2012 and it was then "replaced" by h_1. Finally, we maintain that, for any context c, there is at most one past history of c, that is, a context of utterance can be located only on one history—for example, Context A is located on history h_0, but not on history h_1. The reason for this restriction is that if one admits a context to be located on more than one history, then one also admits a context to have more than one past; if so, it should be possible that a certain sentence about the past

uttered at a certain context could be both true and false in that context, which is something ruled out by the principle of non-contradiction.

Counterintuitive as it may be, our account of (INT1) and (INT2) can also explain away (INT4), while making sense for the power of attraction exerted by this spurious intuition—indeed, it can do this exactly because it is counterintuitive. As we have seen, an intuitive way to think about the time flow from t_0 to t_1 is that of mentally adding new events after t_0 while keeping everything before t_0 unchanged. This way of thinking about the time flow is intuitive for the following reason. Since it is extremely rare to encounter events that bring about a modification in the past, it would drastically diminish the computational efficiency of our temporal information processing if the default and automatic way of this processing took such remote scenario into account. On the basis of this, we can eventually explain away (INT4). Very simply, we tend to have the impression that (INT4) is correct because it conforms to our intuitive way of thinking about time—indeed, the natural way of thinking about the time flow from Context A to Context B is incorporated by Fig. 4 above, and we have seen that this figure represents a model making (6) true in Context B. In a nutshell, (INT4) can be disposed of after realizing that it springs out from a default, but in this case inappropriate, way of thinking about time.

What we have done thus far raises a number of metaphysical questions. We are going to dwell on them in section 7. Before doing that, however, we have to account for (INT5), i.e., the intuition that sentence (19) is true in Context B* (which shares the world and the time with Context B, and can thus be legitimately equated to it for our purposes).

(19) It is no longer the case that Lance Armstrong won the Tour de France in 2000.

We propose that the expression 'it is no longer the case that' is a propositional operator with the following property: when applied to a sentence S expressing a proposition *p* at a context *c*, it yields a complex sentence 'it is no longer the case that S' which is true in *c* at the following conditions:

(c1) *p* is false relative to the circumstance of *c*,
(c2) *p* was true relative to the circumstance of a preceding same-world context to *c*.

Since sentence (19) is obtained by applying the operator 'it is no longer the case that' to sentence (6), and the latter expresses proposition (22), we have that (19) is true in Context B* if and only if:

(c1*) proposition (22) is false relative to the circumstance of Context B*,
(c2*) proposition (22) was true relative to the circumstance of a preceding same-world context to Context B*.

These conditions are satisfied in the model of Fig. 6. Recall that proposition (22) ascribes to the year 2000 the property of being a time in which Armstrong won the Tour de France and is thus true relative to a circumstance if and only if the year 2000 has this property in that circumstance. Given this, (c1*) holds because in h_1 the year 2000 does not have the property of being a time in which Armstrong won the Tour de France, while (c2*) holds because in h_0 the year 2000 has this property. Therefore, our model predicts the correctness of (INT5).

Before concluding this section, we shall consider an apparent counterexample to our analysis. Suppose that someone utters (23) in Context B:

(23) It was still the case in 2002 that Lance Armstrong won the Tour de France in 2000.

Intuitively, (23) is true in this context—let's call this intuition '(INT6).' However, the model in Fig. 6 seems to predict that (23) is false in this context. Indeed, if the expression 'it was still the case in 2002 that' is—as it seems to be—a *purely temporal adverb* in (23), like 'in 2000' in (6), it should take us to the past time 2002 along the world-history of Context B (that is, along h_1), and ask us to evaluate the proposition expressed by 'Lance Armstrong won the Tour de France in 2000' *relative to* h_1. However, if the expression in question really works in this way, we obtain that (23) is false in Context B, since Lance Armstrong did not win the Tour de France in 2000 in h_1.

This objection misfires. In fact, the expression 'it was still the case in 2002 that' is *not* a purely temporal adverb in (23). Notice that this expression applies in (23) to a complete sentence—our old acquaintance (6)—which already contains a past tense bound by the temporal adverb 'in 2000.' Hence, if 'it was still the case in 2002 that' were a purely temporal adverb in (23), the latter sentence would be interpreted as a structure conspiring to bind the same variable twice over, i.e., the past tense of the embedded sentence would be the target of two binding operators. However, since the same occurrence of a variable cannot be

bound more than once, it follows that if 'it was still the case in 2002 that' were a purely temporal adverb in (23), this alleged temporal adverb would be an instance of vacuous binding and (23) would express the same proposition as (6). But (23) does not express the same proposition as (6), as is clear from the observation that (23) and (6) take different truth values in Context B. Therefore, 'it was still the case in 2002 that' is not a purely temporal adverb in (23).[15]

What is its semantic contribution in (23), then? While it cannot be that of a purely temporal adverb, it obviously has to do something with time. Recall that contexts in our account are defined in terms of both times and worlds/world-histories. We propose that 'it was still the case in 2002 that' operates on *both* the time-coordinate and the world-coordinate of the context in (23): the role of this expression in (23) is that of taking us back to a preceding same-world context located on a different world-history and asking us to evaluate the sentence in its scope—i.e., (6)—in this preceding context. More precisely, we analyze this expression into two components: first, the adverb 'in 2002' denotes the context operator that properly takes us back to a preceding same-world context located on a different world-history in 2002; second, 'it is still the case that' is a propositional operator which works as the mirror-image of 'it is no longer the case that', that is, when prefixed to a sentence S expressing a proposition *p* in a context *c*, it yields a complex sentence 'it is still the case that S' which is true in *c* at the following conditions:

(c1) *p* is true relative to the circumstance of *c*,
(c2) *p* is false relative to the circumstance of a successive same-world context to *c*.

Since sentence (23) is obtained by applying 'in 2002' to the result of combining 'it is still the case that' with sentence (6), and (6) expresses proposition (22), we have that (23) is true in Context B if and only if:

[15] We are not claiming that expressions of the form 'it was still the case at time *t* that' are *never* interpreted as purely temporal adverbs. The expression of this form occurring in sentence (i) *is* such an adverb:
(i) It was still the case ten minutes ago that it was raining in Toulouse.
Notice, however, that the past tense in the embedded sentence 'it was raining in Toulouse' is bound only by the temporal expression 'ten minutes ago.' If one tried to bind this tense twice over, as in (ii), the result would be an odd sentence:
(ii) It was still the case ten minutes ago that it was raining in Toulouse one hour ago.

(c1*) proposition (22) is true relative to the circumstance of a context C* situated in 2002, where C* is a preceding same-world context to Context B;

(c2*) proposition (22) is false relative to the circumstance of a successive same-world context to C*.

These conditions are satisfied in the model of Fig. 6. In this way, we can easily account for (INT6).

To sum up, by assuming that the past can change it is possible to account for (INT1), (INT2), (INT5) and (INT6) in a principled way, while explaining (INT4) away at the same time. In the next section, we provide a formalization of the analysis presented thus far.

6.2. Formal analysis

The framework

We adopt a standard type-theoretic framework with λ-abstraction, in which verb predicates denote relations between individuals and events (Davidson, 1967).

Basic types

1. **e**, the type of individuals.
2. **v**, the type of events.
3. **i**, the type of times.
4. **s**, the type of worlds and world-histories.
5. **c**, the type of contexts.
6. **t**, the type of truth values.

Complex types

We shall make use of the following complex types:[16]

1. **<s, t>**, the type of functions from world/world-histories to truth values—*propositions*, for short.
2. **<v, t>**, the type of functions from events to truth values—*event-properties*, for short (this is the type of expressions like 'Lance Armstrong win the Tour de France').

[16] Complex types are derived as usual—if **σ**, **τ** are types, **<σ, τ>** is the type of functions from objects of type **σ** to objects of type **τ**.

3. **<c, t>**, the type of functions from contexts to truth values (functions of this type are involved in the interpretation of sentences like 'It was still the case in 2002 that Lance Armstrong won the Tour de France in 2000').
4. **<<c, t>, t>**, the type of functions from functions of the type in 3. to truth values (the type of context operators like 'in 2002' in a sentence like 'It was still the case in 2002 that Lance Armstrong won the Tour de France in 2000').
5. **<e, <v, t>>**, the type of functions from individuals to event-properties (this is the type of expressions like 'to win the Tour de France').
6. **<<v, t>, <v, t>>**, the type of functions from event-properties to event-properties (this is the type of the past tense).
7. **<i, <v, t>>**, the type of functions from times to event-properties (this is the type of expressions that, at the level of logical form, provide the arguments of time-adverbs like 'in 2000').
8. **<<i, <v, t>>, <v, t>>**, the type of functions from functions of the type in 7. to event-properties (this is the type of time-adverbs like 'in 2000').
9. **<<s, t>, t>**, the type of functions from propositions to truth values (this is the type of intensional operators like 'it is no longer the case that' or 'it is still the case that').

Varieties of functional application

We assume that semantic composition can be done according to three types of functional application:

1. *Basic Functional Application*:
   Let α be a branching node $\alpha = [\beta\ \gamma]$, where β is of type (τ_1, τ_2) and γ is of type τ_1. Then, $[\![\alpha]\!]^{c, g, w} = [\![\beta]\!]^{c, g, w}([\![\gamma]\!]^{c, g, w})$
2. *Intensional Functional Application* (see Heim and Kratzer, 1998):
   Let α be a branching node $\alpha = [\beta\ \gamma]$, where β is of type $((s, \tau_1), \tau_2)$ and γ is of type τ_1. Then, $[\![\alpha]\!]^{c, g, w} = [\![\beta]\!]^{c, g, w}(\lambda w.\ [\![\gamma]\!]^{c, g, w})$
3. *Monstrous Functional Application* (see Rabern, 2012; Santorio, 2012):
   Let α be a branching node $\alpha = [\beta\ \gamma]$, where β is of type $((c, \tau_1), \tau_2)$ and γ is of type τ_1. Then, $[\![\alpha]\!]^{c, g, w} = [\![\beta]\!]^{c, g, w}(\lambda c.\ [\![\gamma]\!]^{c, g, w})$

World-histories

An expression of the form *'w/h'* has to be read as follows: *h* is a world-history of *w*. If h_i, h_j are two world-histories of the same world, *w*, we express this information as follows: 'w/h_i', 'w/h_j'.

Contexts

A context *c* is a pair $<c_w, c_t>$ consisting of a world or a world-history c_w, and a time c_t.

Notable functions and relations

Partial functions

λx_τ: $\phi[x]$. $\psi[x]$ is the function *f* such that:

i. *f* is defined for an object *x* of type τ if and only if the definedness condition ϕ is satisfied;

ii. if defined for *x*, *f* assigns to *x* whatever value is described by ψ.

The application of the function λ*x*: ϕ[*x*]. ψ[*x*] to object *a* yields **{ϕ[*a*]}ψ[*a*]**. The formula **{ϕ[*a*]}ψ[*a*]** is equivalent to the formula **ψ[*a*]**, provided that the definedness condition **ϕ[*a*]** is satisfied. If the definedness condition **ϕ[*a*]** is not satisfied, **{ϕ[*a*]}ψ[*a*]** is undefined.

Existential Closure

We assume a function of Existential Closure that applies to an event-property *P* and yields the statement that *P* is instantiated. Existential Closure is achieved by the operator E-Clos, defined below.

Relations

1. 'WIN(x_e, y_e, e_v, w_s)' means the same as '*e* is a winning event in world *w* of which *x* is the agent and *y* is the theme'.
2. '$c_1 >_C c_2$' ('$c_1 <_C c_2$', respectively) means the same as 'c_1 is a successive same-world context to c_2' ('c_1 is a preceding same-world context to c_2', respectively).
3. '$t_0 <_T t_1$' denotes the relation of precedence between times.

Lexical entries

The denotation function [[·]] applies to an expression ε and assigns to ε a suitable denotation, relative to some parameters, namely, a context *c*, an assignment *g* of values to free variables, and a circumstance *w*.

(24) $[\![\text{Lance Armstrong}]\!]^{c, g, w} = \text{L.A.}$

(25) $[\![\text{to win the Tour de France}]\!]^{c, g, w} = \lambda x_{\text{e}}.\ \lambda e_{\text{v}}.\ \text{WIN}(x, \text{TdF}, e, w)$
(the relation between individuals *x* and events *e* such that *e* is a winning of the TdF in *w* and *x* is the agent of *e*; notice that this relation is context-invariant).

(26) $[\![\text{PAST}_k]\!]^{c, g, w} = \lambda P_{<\text{v, t}>}: g(k) <_{\text{T}} c_t.\ \lambda e_{\text{v}}.\ [P(e) \,\&\, \tau(e) \subseteq g(k)]$[17]
(intuitively, PAST_k locates an event in a time interval $g(k)$ only if the time interval $g(k)$ assigned to variable *k* is in the past of the context).

(27) $[\![\text{in 2000}]\!]^{c, g, w} = \lambda P_{<\text{i, <v, t>>}}.\ \lambda e_{\text{v}}.\ \exists t\ [t \subseteq 2000 \,\&\, P(t)(e)]$
(an operator that binds the tense variable and requires it to be instantiated by a time within the year 2000).

(28) $[\![\text{NO-LONGER}]\!]^{c, g, w} = \lambda p: \exists c'\ [c' <_{\text{C}} c \,\&\, p(c'_w)].\ \sim p(c_w)$[18]
(a propositional operator that, when applied to a proposition *p*, yields a complex proposition NO-LONGER(*p*) which is true in a context *c* at the following conditions: (i) *p* is false at the circumstance of *c*, (ii) *p* is true at the circumstance of a preceding same-world context to *c*).

(29) $[\![\text{STILL}]\!]^{c, g, w} = \lambda p: \exists c'\ [c' >_{\text{C}} c \,\&\, \sim p(c'_w)].\ p(c_w)$[19]

---

[17] See Abusch (1988).

[18] The motivation for regarding $\exists c'\ [c' <_{\text{C}} c \,\&\, p(c'_w)]$ as a presupposition comes from the observation that a sentence like (i), taken at a context in our world, would express a truth-valueless proposition:
(i) It is no longer the case that Bill Clinton won the Tour de France in 2000.
If someone were to utter (i) now (December 2013) in our world, the hearer would be in her own right to object: 'Wait a minute: has it ever been the case that Bill Clinton won the Tour de France in 2000?'

[19] The reason for wanting partial functions as intrepretations of the past, 'no longer', and 'still' comes from considering that sentences like (i)-(iii) would be unacceptable if uttered, say, in a context situated in the actual world on December 6th 2013:
(i) The 2016 Summer Olympics were held in Rio de Janeiro.
(ii) It is no longer the case that President Obama is a Republican.
(iii) It was still the case in 2012 that Hollande was a socialist.
Why would (i)-(iii) be so bad then? On our account, the answer is that the past tense, 'no longer', and 'still' are associated with partial functions that are not defined for the particular arguments to whom they are applied in the derivation of the truth-conditions of those sentences.

(the mirror-image of NO-LONGER, i.e., a propositional operator that, when applied to a proposition *p*, yields a complex proposition STILL(*p*) which is true in a context *c* at the following conditions: (i) *p* is true at the circumstance of *c*, (ii) *p* is false at the circumstance of a successive same-world context to *c*).[20]

(30) $[\![\text{IN 2002}]\!]^{c, g, w} = \lambda P_{<c, t>}. \exists C\, [C_t \subseteq 2002 \,\&\, P(C)]$

(a function taking a property of contexts P and yielding the true if and only if there is a context whose temporal coordinate is part of 2002 which has property P).

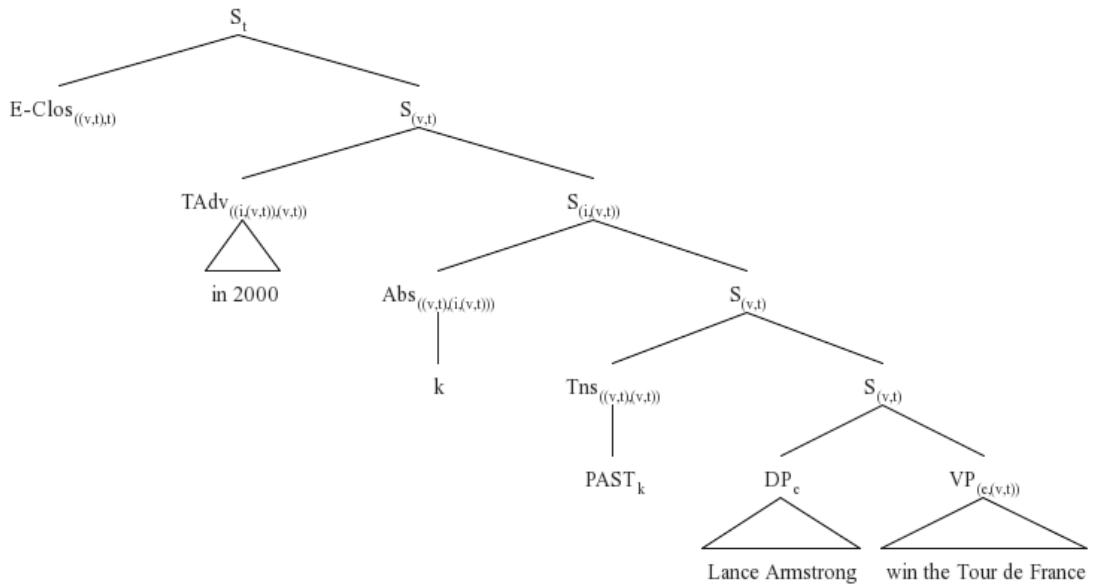
(31) $[\![\text{E-Clos}]\!]^{c, g, w} = \lambda P_{<v, t>}. \exists e\, [P(e)]$

(a function taking an event-property P and yielding the true if and only if there is an event which has property P).

Logical Forms

The Logical Forms of (6), (19) and (23) are given in Fig. 7, 8, and 9, respectively.

Fig. 7. Logical Form of sentence (6).



[20] This analysis does not take into account the modal character exhibited by 'still' in a sentence like (i), uttered in reply to the question whether my project to go to the movies tonight continues to be valid:
(i) I'm still going to the movies tonight.

Fig. 8. Logical Form of sentence (19).

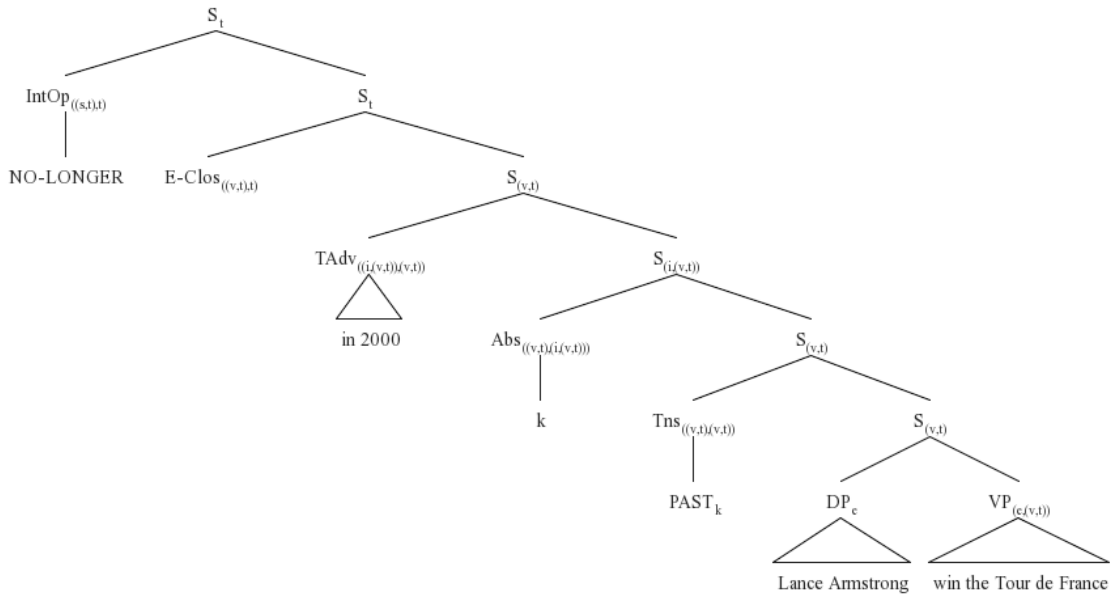
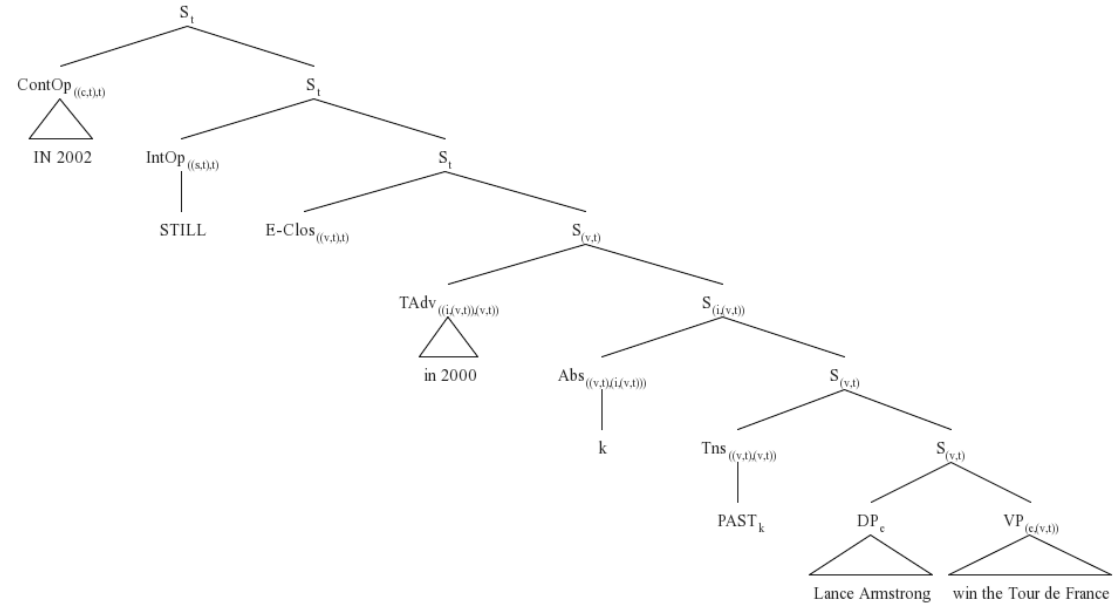


Fig. 9. Logical Form of sentence (23).



Derivation of the general truth-conditions

We apply the function denoted by the VP 'win the Tour de France' to the individual denoted by the proper name 'Lance Armstrong,' to obtain the event-property in (32):

(32) [[Lance Armstrong win the Tour de France]]$^{c,\ g,\ w}$ = (λx_e. λe_v. WIN(x, TdF, e, w))(L.A.) = λe_v. WIN(L.A., TdF, e, w)

(the property of events e such that e is a winning of the Tour de France in w and Lance Armstrong is the agent of e).

The denotation of the past tense applies to the event-property in (32) above, to yield the interpretation in (33):

(33) $[\![\text{PAST}_k[\text{Lance Armstrong win the Tour de France}]]\!]^{c, g, w} = (\lambda P_{<v, t>}: g(k) <_T c_t. \lambda e_v. [P(e) \,\&\, \tau(e) \subseteq g(k)])(\lambda e_v. \text{WIN}(\text{L.A.}, \text{TdF}, e, w)) = \{g(k) <_T c_t\}\lambda e_v. [\text{WIN}(\text{L.A.}, \text{TdF}, e, w) \,\&\, \tau(e) \subseteq g(k)]$

(provided that $g(k)$ be in the past of c_t, the property of events e such that e is a winning of the Tour de France in w and Lance Armstrong is the agent of e and the temporal trace of e is part of the time $g(k)$).

The denotation of the time adverb 'in 2000' is applied to the result of λ-abstracting over the position occupied by the tense variable in the denotation in (33). The result of the λ-abstraction is shown in (34) and the composition with the time adverb in (35):

(34) $[\![\lambda_k[\text{PAST}_k[\text{Lance Armstrong win the Tour de France}]]]\!]^{c, g, w} =$
$\lambda k_i. \{k <_T c_t\}\lambda e_v. [\text{WIN}(\text{L.A.}, \text{TdF}, e, w) \,\&\, \tau(e) \subseteq k]$

(35) $[\![[\text{in 2000 } \lambda_k[\text{PAST}_k[\text{Lance Armstrong win the Tour de France}]]]]\!]^{c, g, w} =$
$(\lambda P_{<i, <v, t>>}. \lambda e_v. \exists t\, [t \subseteq 2000 \,\&\, P(t)(e)])(\lambda k_i. \{k <_T c_t\}\lambda e_v. [\text{WIN}(\text{L.A.}, \text{TdF}, e, w) \,\&\, \tau(e) \subseteq k]) = \lambda e_v. \exists t\, [t \subseteq 2000 \,\&\, \{t <_T c_t\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, w) \,\&\, \tau(e) \subseteq t]]$

The general truth conditions of (6) (relative to an arbitrary context c and arbitrary circumstance w) are thus obtained by instantiating the property of events derived in (35), what is achieved by the Existential Closure operator:

(36) $[\![[\text{E-Clos } [\text{in 2000 } \lambda_k[\text{PAST}_k[\text{Lance Armstrong win the Tour de France}]]]]]\!]^{c, g, w} = 1$
iff $\exists e\, \exists t\, [t \subseteq 2000 \,\&\, \{t <_T c_t\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, w) \,\&\, \tau(e) \subseteq t]]$

The proposition expressed by (6) at Context A and Context B is given in (37) (since any time that is part of the year 2000 precedes both the time of Context A and the time of Context B,

the definedness condition associated with the past tense is satisfied at both these contexts and can thus be discarded):

(37) λw. [[[E-Clos [in 2000 λ_k [PAST$_k$ [Lance Armstrong win the Tour de France]]]]]]$^{\text{Context A, } w} = 1$ =

λw. $\exists e\, \exists t$ [$t \subseteq$ 2000 & $\{t <_{\text{T}}$ Christmas 2002$\}$[WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]] =

λw. [[[E-Clos [in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]$^{\text{Context B, } w} = 1$ =

λw. $\exists e\, \exists t$ [$t \subseteq$ 2000 & $\{t <_{\text{T}}$ Easter 2013$\}$[WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]] =

λw. $\exists e\, \exists t$ [$t \subseteq$ 2000 & WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]

(The proposition which is true at the circumstance w if and only if there is an event of Lance Armstrong winning the Tour de France which occurs in w at a time which is a part of the year 2000).

The general truth conditions of (19) are obtained by applying the propositional operator denoted by NO-LONGER to the proposition in (37), as shown in (38):

(38) [[[NO-LONGER[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]]$^{c, g, w} = 1$ *iff* (λp: $\exists c'$ [$c >_{\text{C}} c'$ & $p(c'_w)$]. $\sim p(c_w)$)(λw. $\exists e\, \exists t$ [$t \subseteq$ 2000 & $\{t <_{\text{T}} c_t\}$[WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]]) = 1 *iff*

$\{\exists c'$ [$c >_{\text{C}} c'$ & $\exists e\, \exists t$ [$t \subseteq$ 2000 & $\{t <_{\text{T}} c_t\}$[WIN(L.A., TdF, e, c'_w) & $\tau(e) \subseteq t$]]]$\}$ $\sim \exists e$ $\exists t$ [$t \subseteq$ 2000 & $\{t <_{\text{T}} c_t\}$ [WIN(L.A., TdF, e, c_w) & $\tau(e) \subseteq t$]]

The general truth conditions of sentence (23) are derived as follows:

(a) the propositional operator denoted by STILL is applied to the proposition in (37), as shown in (39);

(b) λ-abstraction over contexts is run on the result of (a), as shown in (40);

(c) the operator on contexts denoted by IN 2002 is applied to the result of the λ-abstraction in (b), as shown in (41).

(39) [[[STILL[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]]$^{c, g, w}$ = (λp: $\exists C_2$ [$C_2 >_C c$ & $\sim p(C_{2w})$]. $p(c_w)$)(λw. $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T c_t$}[WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]]) =

{$\exists C_2$ [$C_2 >_C c$ & $\sim\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T c_t$}[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T c_t$} [WIN(L.A., TdF, e, c_w) & $\tau(e) \subseteq t$]]

(40) λc. [[[STILL[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]]$^{c, g, w}$ = λC_1. (λp: $\exists C_2$ [$C_2 >_C C_1$ & $\sim p(C_{2w})$]. $p(C_{1w})$)(λw. $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_{1t}$}[WIN(L.A., TdF, e, w) & $\tau(e) \subseteq t$]]) =

λC_1. {$\exists C_2$ [$C_2 >_C C_1$ & $\sim\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_{1t}$}[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_{1t}$} [WIN(L.A., TdF, e, C_{1w}) & $\tau(e) \subseteq t$]]

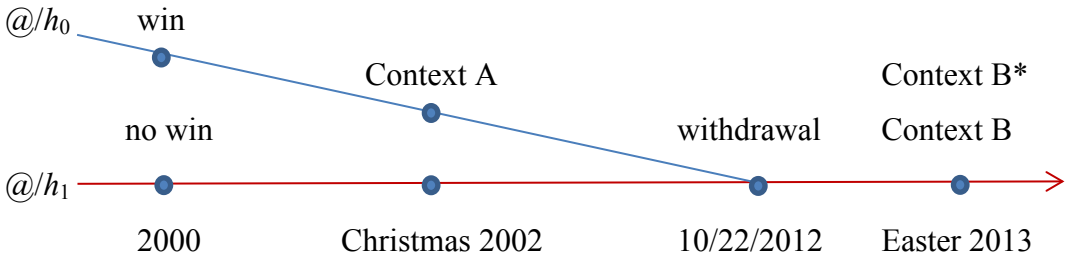
(41) [[[IN 2002[STILL[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]]]$^{c, g, w}$ = 1 *iff* ($\lambda P_{<c, t>}$. $\exists C$ [$C_t \subseteq$ 2002 & $P(C)$])(λC_1. {$\exists C_2$ [$C_2 >_C C_1$ & $\sim\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_{1t}$}[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_{1t}$} [WIN(L.A., TdF, e, C_{1w}) & $\tau(e) \subseteq t$]]) *iff*

$\exists C$ [$C_t \subseteq$ 2002 & {$\exists C_2$ [$C_2 >_C C$ & $\sim\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_t$}[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T C_t$} [WIN(L.A., TdF, e, C_w) & $\tau(e) \subseteq t$]]]

Derivation of the truth values

The model that we assume is given in Fig. 6, repeated here:

Fig. 6. The past history of Context B (red line) and the past history of Context A (blue line).



The truth conditions of (6) in Context A are given in (42):

(42) [[[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]]$^{\text{Context A}, @/h0}$ = 1 *iff* $\exists e$ $\exists t$ [$t \subseteq$ 2000 & {$t <_T$ Christmas 2002}[WIN(L.A., TdF, e, $@/h_0$) & $\tau(e) \subseteq t$]]

(Sentence (6) is true in Context A if and only if there is an event of Lance Armstrong winning the Tour de France occurring in the circumstance of Context A, i.e. $@/h_0$, at a time t within the year 2000—*Definedness condition*: Time t precedes the time of Context A, i.e., Christmas 2002).

The truth conditions of (6) in Context B are given in (43):

(43) $[\![$ [E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]] $]\!]^{\text{Context B}, @/h1} = 1$ *iff* $\exists e\, \exists t\, [t \subseteq 2000\ \&\ \{t <_{\text{T}} \text{Easter2013}\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, @/h_1)\ \&\ \tau(e) \subseteq t]]$

(Sentence (6) is true in Context B if and only if there is an event of Lance Armstrong winning the Tour de France occurring in the circumstance of Context B, i.e. $@/h_1$, at a time t within the year 2000—*Definedness condition*: Time t precedes the time of Context B, i.e., Easter 2013).

The truth conditions of (19) in Context B* are given in (44):

(44) $[\![$ [NO-LONGER[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]] $]\!]^{\text{Context B*}, @/h1} = 1$ *iff* $(\lambda p\colon \exists c'\, [\text{Context B*} >_{\text{C}} c'\ \&\ p(c'_w)].\ \sim p(@/h_1)(\lambda w.\ \exists e\, \exists t\, [t \subseteq 2000\ \&\ \{t <_{\text{T}} \text{Easter 2013}\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, w)\ \&\ \tau(e) \subseteq t]]) = 1$ *iff* $\{\exists c'\, [\text{Context B*} >_{\text{C}} c'\ \&\ \exists e\, \exists t\, [t \subseteq 2000\ \&\ \{t <_{\text{T}} \text{Easter 2013}\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, c'_w)\ \&\ \tau(e) \subseteq t]]]\}\ \sim \exists e\, \exists t\, [t \subseteq 2000\ \&\ \{t <_{\text{T}} \text{Easter 2013}\}[\text{WIN}(\text{L.A.}, \text{TdF}, e, @/h_1)\ \&\ \tau(e) \subseteq t]]$

(Sentence (19) is true in Context B* if and only if no event of Lance Armstrong winning the Tour de France occurs in $@/h_1$ at a time within the year 2000—*Definedness condition*: There is a C which is a preceding same-world context to Context B* such that there is an event of Lance Armstrong winning the Tour de France occurring in the circumstance of C at a time within the year 2000).

The truth conditions of (23) in Context B are given in (45):

(45) $[\![$ [IN 2002 λ_c[STILL[E-Clos[in 2000 λ_k[PAST$_k$[Lance Armstrong win the Tour de France]]]]]] $]\!]^{\text{Context B}, g, @/h1} = 1$ *iff* $(\lambda P_{<\text{c}, \text{t}>}.\ \exists C\, [C_t \subseteq 2002\ \&\ P(C)])(\lambda C_1.\ \{\exists C_2\, [C_2$

$>_C C_1$ & ~$\exists e\ \exists t$ [$t \subseteq$ 2000 & $\{t <_T C_{1t}\}$[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e\ \exists t$ [$t \subseteq$ 2000 & $\{t <_T C_{1t}\}$ [WIN(L.A., TdF, e, C_{1w}) & $\tau(e) \subseteq t$]]) *iff*
$\exists C$ [$C_t \subseteq$ 2002 & $\{\exists C_2$ [$C_2 >_C C$ & ~$\exists e\ \exists t$ [$t \subseteq$ 2000 & $\{t <_T C_t\}$[WIN(L.A., TdF, e, C_{2w}) & $\tau(e) \subseteq t$]]]} $\exists e\ \exists t$ [$t \subseteq$ 2000 & $\{t <_T C_t\}$ [WIN(L.A., TdF, e, C_w) & $\tau(e) \subseteq t$]]]
(Sentence (23) is true in Context B if and only if there is a context C whose time-coordinate is a time within the year 2002 and there is an event of Lance Armstrong winning the Tour de France occurring in the circumstance of C at a time within the year 2000—*Definedness condition*: There is a C_2 which is a successive same-world context to C, such that no event of Lance Armstrong winning the Tour de France occurs in the circumstance of C_2 at a time within the year 2000)

Given the model in Fig. 6 and the truth conditions in (42)-(45) above, we correctly predict the following:

1. Sentence (6) is true in Context A: a 2000 win precedes Context A on world-history $@/h_0$.
2. Sentence (6) is false in Context B: no 2000 win precedes Context B on world-history $@/h_1$.
3. Sentence (19) is true in Context B*: no 2000 win precedes Context B* on world-history $@/h_1$, but a 2000 win precedes a context C on the world-history which is the circumstance of C, where C is a preceding same-world context to Context B*.
4. Sentence (23) is true in Context B: a 2000 win precedes a 2002 context C on the world-history which is the circumstance of C, but there is a C' which is a successive same-world context to C and no 2000 win precedes C' on the world-history which is the circumstance of C'.

7. Philosophical consequences

7.1 From semantics to metaphysics

We started from a philosophical dogma, according to which there cannot be CINP sentences about the past. We proved it to be wrong. Indeed, sentence (6) is context-insensitive, it is about the past in both Context A and Context B, but it is true in Context A and false in Context B, even though the latter is a successive same-world context to the former. On this

basis, we concluded that another dogma has to be given up, namely, the dogma that the past cannot change. Since we did it rather swiftly, let us clarify how we drew this conclusion.

Very simply, the hypothesis that the past *can* change grounds a satisfactory account of the behavior of (6) mentioned above. In addition, it also allows one to correctly predict the truth values of (19) and (23) in their respective contexts, under a plausible compositional semantic analysis of those sentences. Given the explanatory power of this hypothesis, one has good reasons to endorse it, no matter how counterintuitive it might look. Of course, we would be willing to change our minds about the modifiability of the past if you were able to provide us with an alternative semantics for (6), (19), (23) (and related fragments of natural language) which exhibits the same amount of theoretical virtues as our account but is not based on the hypothesis that the past can change. However, if you are not able to do so, you must be willing to accept that the past can change.

This tight link between the semantics of CINP sentences about the past and the metaphysics of the past also indicates what is wrong in The Argument for Truth Value Persistence (see section 2). According to this argument, if one endorses the Kaplanian notion of truth-in-context (Premise P1) and assumes that the past cannot change (Premise P2), one has to conclude that there cannot be CINP sentences about the past. Given that the argument is valid, the existence of CINP sentences about the past requires that at least one of its premises be false. Unsurprisingly, we propose that the culprit is premise P2, which formulates the assumption that the past cannot change as follows: for any context c that is a successive same-world context to C_0, if property Q_p does (not) apply to t relative to the past history of C_0, Q_p does (not) apply to t relative to the past history of c. This premise does not hold in Armstrong's case. Indeed, it is the case that, relative to the past history of Context A, the year 2000 enjoys the property of being a time in which Armstrong won the Tour de France; however, it is not the case that the year 2000 enjoys this property relative to the past history of Context B, even though the latter is a successive same-world context to Context A.

In the next section, we consider what kinds of facts sentences like (6) purport to describe. This will help us to further clarify the metaphysical import of the existence of CINP sentences about the past of the kind we considered in the previous sections.

7.2 Social ontology and the modifiability of the past

It is common in metaphysics to distinguish between *natural facts* (e.g., that gold has atomic number 79, or that the mean distance between the Sun and the Earth is 1.496×10^8 km) from *social facts* (e.g., that there was an economic recession in the 1930s, or that this piece of

paper is a 20€ bill).[21] Among social facts, a particularly interesting category is that of *institutional facts*, like the fact that Angela Merkel is the Chancellor of Germany or the fact that Umberto Eco is an Italian citizen (Searle, 1995; Thomasson, 2003; Ali Khalidi, 2013). For our purposes, we can characterize institutional facts as follows: facts whose existence depends on an assignment of a status function to certain entities by a competent authority. For example, the fact that Umberto Eco is an Italian citizen depends on the Italian Nationality Law assigning the status function of being an Italian citizen to him.

It is immediate to realize that victories in official sport competitions are institutional facts in the sense highlighted above. For instance, the fact that Argentina won the FIFA World Cup in 1986 depends on the fact that FIFA assigned to Argentina the status function of being the winner of the FIFA World Cup in 1986. The same is true of victories at the Tour de France. Since on July 23rd 2000 a competent authority assigned to Armstrong the status function of being the winner of the Tour de France in 2000, and this assignment of status function was still valid on Christmas 2002, *it was a fact* on Christmas 2002 that Armstrong won the Tour de France in 2000. However, since a competent authority withdrew this status function from Armstrong on October 22nd 2012, from that day onwards it has no longer been a fact that Armstrong won the Tour de France in 2000. This, of course, explains why sentence (6) was true if uttered before October 22nd 2012, and false if uttered after that date.

From this, two things follow. First, we claimed that the fact that (6) is not truth-value-persistent is best accounted for by hypothesizing that the past can change. This claim has now to be qualified. Given that the truth (falsity) of (6) is grounded in the existence (non-existence) of a certain institutional fact, all that can be legitimately concluded from the existence of CINP sentences about the past like (6) is that *the set of institutional facts in the past* is not fixed once and for all. Second, if institutional facts are brought into and outside being by assignments of status functions, we should reasonably expect to find other CINP sentences about the past in concomitance with assignments of status functions with *retroactive effect*. This is indeed the case. Consider, e.g., the case of General Robert E. Lee. Having decided in 1861 to serve as General of the Army of Northern Virginia, he forfeited his rights to U.S. citizenship. However, he was officially reinstated as a United States citizen by President Gerald Ford in 1975. Thus, if you had uttered sentence (46) on Christmas 1970, you would have said something false:

[21] It is an open question how to properly characterize the distinction between natural and social facts. The basic intuition is that, while the former can exist independently of any propositional attitude, the latter depend, in some sense or another, on propositional attitudes. A classical discussion of this problem can be found in Searle (1995).

(46) Robert E. Lee was an American citizen in 1866.

However, if you had uttered (46) on Christmas 1980, you would have said something true. So, here is another CINP sentence about the past. Now you know how to account for it. And you also know in what domain you'll have a good chance to find more instances of the infamous kind.

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